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☐	L27	L23 and quartz and teflon and (teflon same (coat$ or layer) same quartz)	6
☐	L26	L25 and piezoelectric	12
☐	L25	L24 and (ultraso$ or megaso$)	24
☐	L24	L23 and quartz and teflon and (teflon same coat$ or layer)	39
☐	L23	134/902.ccls.	1340
☐	L22	piezoelectric and impedance and megasonic and clean$	20
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☐	L20	(1734975| 2468538| 2760501| 3113761| 3441754| 3520724| 3535159| 3771772| 3821834| 4057070| 4391672| 4434384| 4543130| 4602184| 4763677| 4804007| 4836684| 5003999| 5054210| 5137580| 5221421| 5355048)![pn]	22
☐	L19	L18 and impedance	3
☐	L18	5625249	12
☐	L17	5003999.pn.	1
☐	L16	5003999.pn.	1
☐	L15	5137580.pn.	1
☐	L14	5137580.pn.	1
☐	L13	5355048.pn.	1
☐	L12	5355048.pn.	1
☐	L11	l1 and 134/$.ccls.	27
☐	L10	l1 and piezoelectric and teflon and quartz and 134/$.ccls.	1
☐	L9	l1 and transducer and piezoelectric and teflon and quartz	29
☐	L8	L7 and l1	1
☐	L7	6188162.pn.	1
		DB=PGPB; PLUR=YES; OP=ADJ	
☐	L6	L5 and beck.in.	3
☐	L5	acoustic$ impedance	1030

DB=USPT; PLUR=YES; OP=ADJ

☐	L4	L3 and l1	2
☐	L3	6188162.pn. or 6222305.pn.	2
☐	L2	L1 and 134/902.ccls.	6
☐	L1	acoustic$ impedance	4683

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Inventor Name Search Result

Your Search was:

Last Name = KORBLER
First Name = JOHN

Application#	Patent#	Status	Date Filed	Title	Inventor Name 2
60423263	Not Issued	159	11/01/2002	APPARATUS AND METHOD FOR IMPROVED ACOUSTICAL ENERGY TRANSMISSION	KORBLER, JOHN
10699042	Not Issued	030	10/31/2003	SUBSTRATE PROCESS TANK WITH ACOUSTICAL SOURCE TRANSMISSION AND METHOD OF PROCESSING SUBSTRATES	KORBLER, JOHN

Inventor Search Completed: No Records to Display.

Search Another: Inventor **Last Name** KORBLER **First Name** JOHN

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Inventor Name Search Result

Your Search was:

Last Name = GENG
First Name = XUECANG

Application#	Patent#	Status	Date Filed	Title	Inventor Name 2
60423263	Not Issued	159	11/01/2002	APPARATUS AND METHOD FOR IMPROVED ACOUSTICAL ENERGY TRANSMISSION	GENG, XUECANG
10699042	Not Issued	030	10/31/2003	SUBSTRATE PROCESS TANK WITH ACOUSTICAL SOURCE TRANSMISSION AND METHOD OF PROCESSING SUBSTRATES	GENG, XUECANG

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Last Name GENG
First Name XUECANG

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L11: Entry 16 of 27 File: USPT Apr 29, 1997

DOCUMENT-IDENTIFIER: US 5625249 A
TITLE: Megasonic cleaning system

Abstract Text (1):
A megasonic cleaning system utilizes a transducer positioned outside of a cleaning tank to transmit acoustical energy into the cleaning tank. A liquid layer is used to couple the acoustical energy from the transducer to the cleaning tank. An acoustical impedance matching layer, having an acoustical impedance in between that of the transducer and the cleaning fluid, is used to match the impedance of the transducer to that of the cleaning fluid. In one embodiment, the system utilizes at least two transducer arrays and power is switched back and forth between the two arrays. When one array is not being powered, it can be used to listen to the other array.

Brief Summary Text (3):
A further disadvantage of the prior megasonic cleaning systems is that they do not provide high levels of acoustical impedance matching between the transducers and the cleaning fluid. This does not allow for maximum energy transfer between the transducers and the cleaning liquid. In this regard, it is noted that U.S. patent application Ser. No. 08/139,981, filed Sep. 28, 1993, (hereinafter "the '981 application"), of which the inventor of the present application is a coinventor, discloses the use of a transducer mounted in a quartz tube which is in turn mounted inside a cleaning tank. The quartz tube is a quarter wavelength thick and acts as an impedance matching layer between the transducer and the cleaning fluid in the tank. Quartz, however, is not an optimal impedance matching layer. The invention disclosed in the '981 application, because it has been on sale for more than a year, is prior art to the invention of the present application. The disclosure of the '981 application is hereby incorporated in the present application by reference.

Detailed Description Text (2):
FIGS. 1 & 2 shows a megasonic cleaning system in accordance with the present invention. It has a quartz cleaning tank 10 which removeably mounted on a tank frame 11. The tank can be filled with any appropriate cleaning fluid and the tank is typically made of quartz. Positioned below the tank are two transducer arrays 1 & 2. As is shown in FIGS. 3 and 3a, an acoustical impedance matching layer is coupled to the top of the transducers in the transducer arrays and serves to match the acoustical impedance of the transducers to that of the cleaning fluid. Referring back to FIGS. 1 and 2, a cavity 15, filled with liquid, acoustically couples the top of the matching layer to the bottom of the tank 10. This method of liquid coupling allows for the tank to be easily separated from the transducer arrays so that other

tanks can be used with them as well. Hydraulically actuated wipers 20 positioned in the cavities 15 are used to wipe away bubbles from the top surface of the matching layer and from the bottom surface to the cleaning tank 10.

Detailed Description Text (6):
FIG. 3 shows a sectional view of a transducer frame 12. As shown in the enlarged FIG. 3a, the frame 12 supports transducers 30 which typically are ceramic piezo electric crystals. The frame 12 is made of PEEK plastic which has low thermal expansion characteristics. Coupled to the top of the transducers 30 and the frame 12 is an impedance matching layer 31. As previously indicated, the impedance matching layer has an impedance in between that of the transducers and that of the cleaning fluid. Ideally the impedance of the matching layer has a thickness equivalent to an odd multiple of the quarter wavelength of the acoustic energy in the matching layer. Further, the matching layer ideally has an acoustic impedance (Zm) which is the geometric mean of the impedance of the transducer (Zt) and the impedance of the cleaning fluid (Zc). Thus the ideal impedance of the matching layer is given by the equation Zm=.quadrature.(Zt*Zc).

Current US Cross Reference Classification (1):
134/147

Current US Cross Reference Classification (2):
134/184

CLAIMS:

1. A megasonic cleaning system for cleaning articles such as semiconductor wafers comprising:

a cleaning tank adapted to hold cleaning liquid and an article to be cleaned in said cleaning liquid;

a transducer for converting electrical energy into acoustical energy, said transducer having at least first and second opposite sides, said transducer mounted outside of, spaced from and with said first side facing said cleaning tank, said transducer having an acoustical impedance greater than that of the cleaning liquid;

a source of oscillating electrical energy electrically coupled to said transducer for driving said transducer to produce said acoustical energy at substantially megasonic frequencies;

an impedance matching layer interposed between said first side of said transducer and said cleaning fluid, said matching layer having an acoustical impedance between that of said transducer and that of said cleaning liquid, said matching layer being coupled to said first side of said transducer, said matching layer and said cleaning tank being acoustically coupled together by an intervening liquid layer and an acoustically matched backing layer not being coupled to said second side of said transducer.

3. A megasonic cleaning system comprising:

a cleaning tank adapted to hold cleaning liquid and an article to be cleaned in said cleaning liquid;

a transducer for converting electrical energy into acoustical energy, said transducer mounted outside of, spaced from and oriented to transmit acoustical energy into said cleaning tank, said transducer having an acoustical impedance greater than that of the cleaning liquid;

a source of oscillating electrical energy electrically coupled to said transducer for driving said transducer to produce said acoustical energy at substantially megasonic frequencies;

an impedance matching layer interposed between said transducer and said cleaning fluid, said matching layer having an acoustical impedance between that of said transducer and that of said cleaning liquid;

said matching layer being coupled to said transducer, said matching layer and said cleaning tank being acoustically coupled together by an intervening liquid layer with said transducer, matching layer and intervening liquid layer being positioned below said cleaning tank;

a wiper positioned in said liquid layer between a bottom surface of said tank and a top surface of said matching layer, said wiper being adapted to periodically wipe bubbles from said top and bottom surfaces.

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L27: Entry 5 of 6 File: USPT Apr 27, 1999

DOCUMENT-IDENTIFIER: US 5896875 A
TITLE: Equipment for cleaning, etching and drying semiconductor wafer and its using method

Brief Summary Text (4):
Referring to a conventional dip-type cleaner, as shown in FIG. 8, a wafer d to be cleaned which is accommodated in a teflon cassette c is disposed on a mesh b within a bath a which is a container made of quartz or Teflon (PFA or the like) having chemical resistance, then a chemical introducing valve e is opened to introduce and fill a chemical in the bath a through a chemical introducing line f, thereby immersing the wafer d in the chemical in the bath a. In the cleaner, in order to reduce the chemical consumption, a chemical circulation line h is provided for returning the chemical, which is discharged from a drain port provided at the bottom of the bath a, into the bath a again after filtering by a filter g. After treating with the chemical, a ultrapure water introducing valve i is opened to introduce ultrapure water through an ultrapure water introducing line j into the bath a, thereby the chemical is cleaned out from the surface of the wafer d and from the bath a. Wherein, respective references k and l are three-way valves provided in the middle of the chemical circulation line h.

Brief Summary Text (6):
However, the wafer d is immersed in the chemical in the aforementioned dip-type cleaner, which requires large amounts of chemical and ultrapure water, while displaying remarkable power of removing particles and contaminant adhered to the wafer surface. According to plain calculation, chemical of about 65 litters is required for processing 50 wafers d of 200 mm diameter in the Teflon cassette c, and ultrapure water of about 40 litters per minute is required for water rinsing. To save the chemical in even a small amount, the chemical is reused by circulating and filtering it in a set cycle, which contaminates again the wafer surface, because the chemical once contaminated by impurities or by particles eluted thereinto cannot be cleaned even by filtering. Further, it is impossible to reuse circulated and filtered ultrapure water for water rinsing. The conventional operation sequence from cleaning to drying requires transportation of the wafer d among a plurality of baths and equipments D1, D2, E, F, which lowers operation efficiency and causes generation of stain or water marks, water spots due to exposure of the wafer to the air at transportation.

Detailed Description Text (3):
FIG. 1 shows an equipment for cleaning, etching and drying according to the embodiment of the present invention, wherein reference numeral 1 denotes a process chamber having a closed space 2, which is made of quartz coated with

Teflon PFA. Chamber heaters 3 are respectively provided on the side surfaces and upper face of the process chamber 1 for controlling temperature in the closed space 2 of the process chamber 1 and for preventing inside of the process chamber 1 from being dried and forming dew.

Detailed Description Text (4):
A grating or mesh 4 is provided as a supporting member at the lower center part in the process chamber 1, and a wafer cassette 6 made of Teflon and accommodating at least one wafer 5 to be cleaned is disposed at a set position on the mesh 4 and is fixed with a holder (not shown). A plurality of spray nozzles 7 (three in FIG. 1) linearly extending parallel to one another are arranged at the upper part in the process chamber 1, and a rotary discharge nozzle 8 is arranged at the lower part in the process chamber 1.

Detailed Description Text (8):
Each of the spray nozzles 7 is composed of a pipe made of Teflon PFA, and includes, though not shown, a plurality of spray ports for spraying chemical and ultrapure water and a plurality of nitrogen gas blow-out ports for atomizing the chemical and ultrapure water, both of which are provided at almost regular intervals in a direction that the respective spray nozzles 7 extend (direction across at a right angle to paper in the drawing). A chemical/ultrapure water supply line 16 is connected to the spray ports of the chemical and ultrapure water, and a nitrogen gas supply line 17 is connected to the nitrogen gas blow-out ports.

Current US Cross Reference Classification (12):
134/902

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☐	L15	5137580.pn.	1
☐	L14	5137580.pn.	1
☐	L13	5355048.pn.	1
☐	L12	5355048.pn.	1
☐	L11	l1 and 134/$.ccls.	27
☐	L10	l1 and piezoelectric and teflon and quartz and 134/$.ccls.	1
☐	L9	l1 and transducer and piezoelectric and teflon and quartz	29
☐	L8	L7 and l1	1
☐	L7	6188162.pn.	1
		DB=PGPB; PLUR=YES; OP=ADJ	
☐	L6	L5 and beck.in.	3
☐	L5	acoustic$ impedance	1030
		DB=USPT; PLUR=YES; OP=ADJ	
☐	L4	L3 and l1	2
☐	L3	6188162.pn. or 6222305.pn.	2
☐	L2	L1 and 134/902.ccls.	6
☐	L1	acoustic$ impedance	4683

END OF SEARCH HISTORY

L19: Entry 3 of 3 File: USPT Apr 29, 1997

DOCUMENT-IDENTIFIER: US 5625249 A
TITLE: Megasonic cleaning system

Abstract Text (1):
A megasonic cleaning system utilizes a transducer positioned outside of a cleaning tank to transmit acoustical energy into the cleaning tank. A liquid layer is used to couple the acoustical energy from the transducer to the cleaning tank. An acoustical impedance matching layer, having an acoustical impedance in between that of the transducer and the cleaning fluid, is used to match the impedance of the transducer to that of the cleaning fluid. In one embodiment, the system utilizes at least two transducer arrays and power is switched back and forth between the two arrays. When one array is not being powered, it can be used to listen to the other array.

Brief Summary Text (3):
A further disadvantage of the prior megasonic cleaning systems is that they do not provide high levels of acoustical impedance matching between the transducers and the cleaning fluid. This does not allow for maximum energy transfer between the transducers and the cleaning liquid. In this regard, it is noted that U.S. patent application Ser. No. 08/139,981, filed Sep. 28, 1993, (hereinafter "the '981 application"), of which the inventor of the present application is a coinventor, discloses the use of a transducer mounted in a quartz tube which is in turn mounted inside a cleaning tank. The quartz tube is a quarter wavelength thick and acts as an impedance matching layer between the transducer and the cleaning fluid in the tank. Quartz, however, is not an optimal impedance matching layer. The invention disclosed in the '981 application, because it has been on sale for more than a year, is prior art to the invention of the present application. The disclosure of the '981 application is hereby incorporated in the present application by reference.

Brief Summary Text (6):
There is provided, in accordance with the present invention, an improved megasonic cleaning system which does not possess the shortcomings of the prior art and offers the advantages of allowing a plurality of cleaning tanks to be used interchangeably with one group of transducers, of providing effective impedance matching between the transducers and the tank and of monitoring the operation of the transducers.

Brief Summary Text (8):
Theses and other objects of the present invention are provided by a megasonic cleaning system which in one embodiment utilizes a liquid layer to couple

acoustic energy from transducers positioned outside of the cleaning tank to the cleaning tank itself. A dedicated impedance matching layer can be coupled to the transducers to match the impedance of the transducers to that of the cleaning fluid. In one embodiment, the megasonic cleaning system may be comprised of two separate arrays which are alternately powered by the same power supply. This allows a single power supply to be utilized where normally two would be needed. In a further aspect of this invention, the each transducer array, when it is not being powered, can be used to listen to the other array. This provides an economical and effective method of monitoring the performance of both arrays.

Drawing Description Text (5):
FIG. 3a is enlarged view of a section of FIG. 3 showing the impedance matching layer.

Drawing Description Text (6):
FIG. 4 is a top view of a mounting frame holding four piezo electric transducers and is shown without the impedance matching layer.

Drawing Description Text (9):
FIG. 7 is a side view of the FIG. 1 megasonic cleaning system showing plumbing used to supply the deionized water layer between the top surface of the impedance matching layer and the bottom surface of the cleaning tank.

Detailed Description Text (2):
FIGS. 1 & 2 shows a megasonic cleaning system in accordance with the present invention. It has a quartz cleaning tank 10 which removeably mounted on a tank frame 11. The tank can be filled with any appropriate cleaning fluid and the tank is typically made of quartz. Positioned below the tank are two transducer arrays 1 & 2. As is shown in FIGS. 3 and 3a, an acoustical impedance matching layer is coupled to the top of the transducers in the transducer arrays and serves to match the acoustical impedance of the transducers to that of the cleaning fluid. Referring back to FIGS. 1 and 2, a cavity 15, filled with liquid, acoustically couples the top of the matching layer to the bottom of the tank 10. This method of liquid coupling allows for the tank to be easily separated from the transducer arrays so that other tanks can be used with them as well. Hydraulically actuated wipers 20 positioned in the cavities 15 are used to wipe away bubbles from the top surface of the matching layer and from the bottom surface to the cleaning tank 10.

Detailed Description Text (4):
Referring back to FIG. 1 it can be seen that coupled to the underside of the tank frame 11 is a removable box 14. Box 14 includes transducer frame 12 for holding an array of megasonic transducers and an impedance matching layer. Also enclosed in the box are transformers which match the electrical impedance of the power supply to that of the transducers. Gasket 13 seals the box against the bottom of tank frame 11. Cavity 15 is formed between transducer frame 12, the tank frame 11 and the bottom of the cleaning tank 10. Cavity 15 is preferably filled with deionized water which serves to couple megasonic acoustic energy produced by the transducers to the tank 10 and into the cleaning fluid in the tank.

Detailed Description Text (6):

FIG. 3 shows a sectional view of a transducer frame 12. As shown in the enlarged FIG. 3a, the frame 12 supports transducers 30 which typically are ceramic piezo electric crystals. The frame 12 is made of PEEK plastic which has low thermal expansion characteristics. Coupled to the top of the transducers 30 and the frame 12 is an impedance matching layer 31. As previously indicated, the impedance matching layer has an impedance in between that of the transducers and that of the cleaning fluid. Ideally the impedance of the matching layer has a thickness equivalent to an odd multiple of the quarter wavelength of the acoustic energy in the matching layer. Further, the matching layer ideally has an acoustic impedance (Zm) which is the geometric mean of the impedance of the transducer (Zt) and the impedance of the cleaning fluid (Zc). Thus the ideal impedance of the matching layer is given by the equation Zm=.quadrature.(Zt*Zc).

Detailed Description Text (7):
FIG. 4 shows a top view of a transducer array of a megasonic cleaning system in accordance with the present invention. It has four separate megasonic transducers 41, 42, 43 & 44. The four transducers of each array are divided into two sets of two transducers each. Each set of two transducer is supplied with power from a group of three transformers as shown in FIG. 3. This provides a two-stage electrical impedance matching arrangement. In the first stage, transformer 32 cuts the impedance of the power supply from approximately 50 Ohms to approximately 10 Ohms. In the second stage, transformers 33 & 34 cut the impedance to 3-4 Ohms depending upon the characteristics of the individual transducers 43 & 44. Thus when each transducer array is built, the second stage transformers are individually selected to match the impedance of the supplied power to the individual transducers which are used. Because 3 transformers are used in conjunction with every two transducers, each array utilizes a total of six transformers and the total system, comprised of two arrays, uses a total of 12 transformers.

CLAIMS:

1. A megasonic cleaning system for cleaning articles such as semiconductor wafers comprising:

a cleaning tank adapted to hold cleaning liquid and an article to be cleaned in said cleaning liquid;

a transducer for converting electrical energy into acoustical energy, said transducer having at least first and second opposite sides, said transducer mounted outside of, spaced from and with said first side facing said cleaning tank, said transducer having an acoustical impedance greater than that of the cleaning liquid;

a source of oscillating electrical energy electrically coupled to said transducer for driving said transducer to produce said acoustical energy at substantially megasonic frequencies;

an impedance matching layer interposed between said first side of said transducer and said cleaning fluid, said matching layer having an acoustical impedance between that of said transducer and that of said cleaning liquid, said matching layer being coupled to said first side of said transducer, said

matching layer and said cleaning tank being acoustically coupled together by an intervening liquid layer and an acoustically matched backing layer not being coupled to said second side of said transducer.

3. A megasonic cleaning system comprising:

a cleaning tank adapted to hold cleaning liquid and an article to be cleaned in said cleaning liquid;

a transducer for converting electrical energy into acoustical energy, said transducer mounted outside of, spaced from and oriented to transmit acoustical energy into said cleaning tank, said transducer having an acoustical impedance greater than that of the cleaning liquid;

a source of oscillating electrical energy electrically coupled to said transducer for driving said transducer to produce said acoustical energy at substantially megasonic frequencies;

an impedance matching layer interposed between said transducer and said cleaning fluid, said matching layer having an acoustical impedance between that of said transducer and that of said cleaning liquid;

said matching layer being coupled to said transducer, said matching layer and said cleaning tank being acoustically coupled together by an intervening liquid layer with said transducer, matching layer and intervening liquid layer being positioned below said cleaning tank;

a wiper positioned in said liquid layer between a bottom surface of said tank and a top surface of said matching layer, said wiper being adapted to periodically wipe bubbles from said top and bottom surfaces.

6. A megasonic cleaning system according to claim 1 wherein said matching layer has an impedance approximately equal to the geometric mean of the impedances of the transducer and the cleaning fluid.

L11: Entry 8 of 27 File: USPT Feb 29, 2000

DOCUMENT-IDENTIFIER: US 6030463 A
TITLE: System and method for ultrasonic cleaning and degreasing

Detailed Description Text (145):
Acoustic Impedance Considerations

Detailed Description Text (147):
"The styrofoam-filled holes display the highest degree of signal loss . . . . This is to be expected because styrofoam consists primarily of air bubbles which have an acoustic impedance very different from that of Lucite [the surrounding material]."

Detailed Description Text (148):
Miller goes on to show grayscale images indicating a 15 dB signal loss in styrofoam as compared to approximately 5 dB in other materials such as Lucite, epoxy, or glass/epoxy compounds. These statements are misdirected in the context of ultrasonic cleaning, since it is not the difference in acoustic impedance which results in the attenuation of ultrasonic energy, but rather the fact that the acoustic impedance is higher in styrofoam than materials such as Lucite. Information on the subject of acoustic impedance and its relevance to the topic of ultrasonics is generally available in the literature. See Karl F. Herzfeld and Theodore A. Litovitz, ABSORPTION AND DISPERSION OF ULTRASONIC WAVES (LOC #59-7683, 1959).

Detailed Description Text (149):
This is not to imply that a suitable ballast cannot be constructed of styrofoam. However, the present invention envisions that the best construction method in this instance would be to use the styrofoam as a mold form over which a material with a low acoustic impedance is coated. This configuration prevents the ultrasonic energy associated with resonances in the containment vessel from being dissipated within the ballast support. Suitable mold coatings might include plastic, wax, and the like, although a wide variety of materials are both suitable and envisioned by the scope of the present invention.

Detailed Description Text (150):
Thus, the containment vessel should be constructed of a material which has a low acoustic impedance, with minimal real and imaginary loss components. This makes most substances such as styrofoam and other gas-filled materials unsuitable for use in containment vessels. Furthermore, this result means that common industrial techniques such as the use of rubber bands and the like to hold/retain the containment vessel (beaker, etc.) as illustrated in FIG. 13 should be avoided, as ultrasonic energy is damped by these materials.

This damping permits ultrasonic energy to be drained from any containment vessel in contact with such a lossy material, resulting in less cavitation at the cleaning target than could be had otherwise.

Current US Original Classification (1):
134/1

Current US Cross Reference Classification (1):
134/147

Current US Cross Reference Classification (2):
134/184

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L3	6188162.pn. or 6222305.pn.	2	L3
L2	L1 and 134/902.ccls.	6	L2
L1	acoustic$ impedance	4683	L1

END OF SEARCH HISTORY